The Population Ecology Paradigm: Review And Critique

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ABSTRACT

The population ecology paradigm gained acceptance in the organizational theory literature during the late 1970's and continues to influence the discipline. The paradigm draws heavily on the Darwinist notion of survival of the fittest. The application of ecological theories to the study of organizations was first proposed by Hannan and Freeman (1977). The following paper provides an overview and critical analysis of the extant literature. The paper concludes by suggesting that industrial economics provides a richer framework for analyzing organizational structures.

OVERVIEW

The population ecology paradigm gained acceptance in the organizational theory literature during the late 1970's and continues to influence the discipline. The paradigm draws heavily on the Darwinist notion of survival of the fittest. In its purest form population ecology equates the process of organizational survival to the competition for essential resources. Organizations which are successful in this process gain control over resources which allow them to flourish and grow; those that do not are "selected out" by their environment. According to Young, "The exponents of this way of thinking apply concepts, theories, methods and models derived from the biological study of the fluctuations of plant and animal populations to the "populations" of organizations." (Young, 1988, p. 1)

One of the distinguishing features of this paradigm is that research is carried out at the population level as opposed to the organizational level. The shift to the population level of analysis lends a scientific approach to the study of the organizations; i.e., organizations can be classified into populations, generalizations about populations of organizations can be made and predictions about organizational behavior are facilitated. The drawback to this approach is that many traits unique to individual organizations are lost in this aggregation process. In fact, this macro level of analysis may obscure many of the causal links between particular organizational characteristics and organizational survival rates.

The concept of niche is central to the population ecology paradigm. A niche "is defined in terms of a set of constraints in abstract space that are sufficient to maintain a species." (Young, 1988, p. 5). These constraints are a fixed set of resources which are necessary to sustain a given number of similar organizations, i.e., a population. Each niche has an upper bound or carrying capacity. Competition for resources occurs within the niche and in the short run individual organizations who are unsuccessful in this competitive process are selected out. However, over longer periods of time, as resources within the niche are exhausted the survival of the entire population of organizations is at risk. In fact, the population ecologist would argue that although there exists variability in survival rates of particular organizations within a niche, which could be attributed to differences in efficiency levels between individual organizations, the fate of the entire population follows a much more deterministic process.

The operative concept in population ecology is that the environment selects organizations for survival. The logical conclusion which follows this line of reasoning is that managers have no role in shaping organizational strategy. Astely and Van de Ven (1983) in a two-dimensional analysis, parameterized by macro vs. micro level of analysis and deterministic vs. voluntaristic orientation, categorize the role of management in the population ecology paradigm to be one of inaction. The remaining three combinations classify managers as either reactive, proactive or interactive with their environments.

Theoretical Contributions

According to McKelvey and Aldrich (1983) the acceptance of the population ecology paradigm by organization theorists is a breakthrough for the following reasons, "Our view is that is [the population ecology paradigm] has several clear advantages: (1) it offers a way to break the mental set of the existing models, as its theory and concepts sensitize us to see the organizational world in a new way; (2) it already has in place many essential concepts; and (3) the theoretical and methodological issues are already identified, so we have a map showing where all of the difficulties and points of interest are likely to be." (p. 108).

Two of the most prominent researchers who work within the population ecology framework are Michael T. Hannan and John Freeman. Hannan and Freeman (1977) argue the capacity of organizations to adapt to a changing environment is much more limited than traditional organization theories would acknowledge. Hannan and Freeman contend that certain inertial pressures can be either internal, such as illiquid resources committed to long-term capital projects, or external, such as legal and fiscal barriers which place boundaries around the environment in which an organization can operate. A constrained set of choices leads to the proposition that managers may not be able to select those strategies which would otherwise optimize firm survival rates.

Following on this theme, Kaufmann (1973, 1975) in Whetten (1980) argues that, "most models of organizational processes are overly rational." (p. 348). Kaufman implies that since very few old organizations continue to exist organizational survival rates may indeed follow a deterministic process.

Researchers have grappled with this issue at the population level and have employed empirical techniques, such as random walk models (Levinthal, 1991), to analyze and make predictions about the survival rates within entire populations or industries. As with any modeling process assumptions must be made in order to isolate the relationships between variables. The assumptions on which a paradigm rest often will drive the research questions and ultimately the results.

Due to the deficiencies cited above and other reasons, the population ecology paradigm has come under criticism in recent years. Section II highlights the key criticisms of the paradigm. Section III puts forth an alternative approach for studying organizations *in the context of environmental determinism and resource competition.* Section IV concludes the discussion.

CRITIQUE OF THE POPULATION ECOLOGY PARADIGM

In recent year the population ecology paradigm has been criticized in the organization theory literature. The following points synthesize the main objections to the paradigm.

Births and Deaths

First of all, much of the population ecology literature is centered on the occurrence of organizational "births" and "deaths". These very concepts are difficult to operationalize which can complicate and weaken the usefulness of empirical studies. From a data collection standpoint organizational "births" can be traced to incorporation filings, business registrations and other government documents. However the legal inception of a business may not correlate with the start of actual operations. In fact this lag may be several years. This is not a trivial matter, since several population ecology studies (Bruderl and Schussler, 1990; Pennings, 1982) conclude that environments which are resource rich will foster conditions which are conductive to the start-up of many enterprises. However, other factors, such as downsizing or the closure of a key industry within a geographical area may prompt individuals to initiate businesses. One could argue that resources, both human and other, are simply being transformed from one industry to another. Again, not being able to clearly define the birth date of a new business may lead researchers to form erroneous conclusions.

Defining organizational deaths represents an even more problematic research issue. According to the population ecology literature organizations can die in one of two ways: they either cease to exist altogether by

declaring bankruptcy or liquidating or they are acquired by other organizations. While the former clearly represents organizational failure the latter point emphasizes the ability of an organization to adapt to its environment by changing organizational form. Although in both instances the organization ceased to exist in its original form, the process leading to the death is very different. An organization which declares bankruptcy is, among other things, one which failed to employ resources in their most efficient manner. An accumulation of operating losses is synonymous with allocational inefficiencies of resources. In contrast, an organization which is acquired, whole, by another organization by definition must have a value which exceeds the sum total of its assets otherwise no other entity would be willing to purchase it *as an organization.*

While the cloudy issue of what exactly constitutes an organizational birth or death may also plague researchers working in other paradigms most of the literature and research in the population ecology paradigm deals with such issues as the liability of newness or organizational mortality rates. Until organizational births and deaths can be clearly defined the useful of the paradigm as a research framework remains incomplete.

Predictive Value

A second criticism centers around the predictive value of the population ecology paradigm. To repeat, population ecology theorists emphasize the competition for resources as the determining factor in organizational survival rates and view management as largely passive. Organizations are particularly vulnerable to their environments during their early years, the so-called liability of newness, because of their failure to accumulate slack resources which are necessary to deal with contingencies. However, Romanelli's (1989) longitudinal study of the microcomputer industry, conducted in the population ecology framework concludes that "environmental conditions at founding and organizational strategies *jointly* (emphasis added) affect the survival likelihood of young firms." She goes on to state, "competition [for resources] is an insignificant predictor of survival likelihoods both as a main effect and in interaction with strategy variables. Previous literature, as well as the logic presented in this paper, suggests that strong and/or intense competition for resources should increase the risk of failure for young and relatively resource-poor organizations." (Romanelli, 1989, p. 385).

Another population ecology paper, (Levinthal, 1991), contained the following quote, "Lotus Corporation, despite the turbulence of the computer software industry, is buffered from selection pressure due to the phenomenal success of its initial product introduction. Despite Lotus's subsequent difficulties in introduction new products and extending its product line, it is not faced with the imminent prospects of failure." (Levinthal, 1991, p. 399). Was the 1995 acquisition of Lotus by IBM an organizational failure? A rigid interpretation of the population ecology definition of failure would suggest so, since organizational failures occur when an organization, in its present form, ceases to exist.

Role of Management

Viewing management as largely passive or inactive is perhaps the most widely cited weakness of the population ecology paradigm. A competing framework, contingency theory, shares with the population ecology paradigm the role environmental determinism plays in shaping organizational survival rates. However, contingency theory, by shifting the level of analysis to the organizational level, defines the role of managers to be reactive, as opposed to inactive, to their environments. According to Astley and Van de Ven (1983), "contingency theorists have emphasized that organizations respond to change by modifying or elaborating their internal structures to maintain an isomorphic relationship with the environment." (p. 253).

Level of Analysis

A related criticism is that the shift of the study of organizations to the population level drives the results of the population ecology studies. If one studies entire populations of organizations over relatively long periods of time the population ecology framework may provide some insights into organizational survival rates. However, this highly aggregate level of analysis tells us nothing about the processes which cause an organization to fail or succeed. And shifting the analysis to the population level may actually lead to conclusions which differ if the analysis were done at

the organizational level. For example, a growing industry may be able to command control over an increasing resource base. Resource abundance may therefore attract new entrants to the industry. Additional competition within the niche for resources may actually *decrease* an individual organization's chances for survival although the industry or population as a whole may have *increased* its chances for survival.

Biological Origins

One of the fundamental flaws in the population ecology literature remains that its foundations are rooted in biological theories. Young (1988) delineates many of the theoretical inconsistencies researchers encounter when trying to overlay ecological theories to the study of populations of organizations. One of the most obvious inconsistencies is that mortality rates for living organisms increase with age while older organizations have lower mortality rates. Another issue centers around the ability to classify organizations into populations. The processes which biologists use to classify living organisms may be of little use to organizational theorist who are attempting to classify organizations.

Is This a Positive Theory?

Positive theorists analyze the state of the world and attempt to describe and make predictions about it. The larger question remains, is the population ecology paradigm a positive theory? Hannann and Freeman (1977) contend that the combination of a fixed resource base coupled with similar populations competing for those resources will necessarily lead to competition and that the population most suited to its environment will be "selected in." However, this prediction rests on two very questionable assumptions. First of all, although resources may be considered fixed at any point in time, the productive capacity of nearly all resources in the economy increases over time. In fact, qualitative improvements allow an increasing level of output to be produced with the same quantitative levels of inputs. For example, in an environment characterized by labor scarcity the population ecology paradigm would predict that organizations would compete for workers and those unsuccessful in the process would cease to exist. However, experience tells us that organizations adopt to the environment by employing capital intensive production techniques which allow for the substitution of capital for labor.

A second issue revolves around the definition of similar populations. Should organizations be classified according to size, age, product, markets served, or some combination of the above? Again, although organization theorists working in other paradigms confront the problem of developing typologies, the population ecology paradigm *hinges on* the ability to classify organizations.

At its best the population ecology approach to the study of organizations invokes an interesting metaphor; at its worst the paradigm leads researchers to inconsistent or contradictory conclusions. A more useful theoretical foundation for studying organizations at the macro level and in the context of resource competition is derived from industrial economics. The next section analyzes this paradigm.

INDUSTRIAL ECONOMICS: AN ALTERNATIVE PARADIGM

Comparison and Contrast with the Population Ecology Paradigm

Astley and Van de Ven (1983) classify both population ecology and industrial economics as the foundations upon which to build organization theories at the macro level combined with a deterministic orientation. In fact, the two paradigms share many similarities. However, there also exist significant differences between the two theoretical frameworks.

The parallels between industrial economics and population ecology are many. Both have their origins in Darwinistic notions of survival of the fittest. However, the influence of Darwinist ideas on the economies profession reached a climax at the end of the nineteenth century whereas the basic "selection" principle continues to pervade the population ecology literature. Although the field of industrial economics has been a sub-speciality within the economies discipline for over one hundred years its influence has ebbed and flowed. Like population ecology, its

attractiveness to researchers increased during the 1970's due to "growing doubt over the adaptability and responsiveness of modern industrial enterprises." (Scherer, 1980, p. 3)

Similar to population ecology, industrial economics analyzes organizations at the aggregate, or industry, level. The field also examines the "location and ownership of essential raw materials" (Scherer, 1980, p. 3) as a determining factor of market structures. The creation of new industries, shifting patterns of economic organization and the decline of entire industries are also the subject of inquiry of industrial economic studies. Industrial economics also analyze the functional relationship between models of economic organization and organizational structures.

However, there also exist significant differences between the population ecology paradigm and industrial economics from both a theoretical and operational perspective. The largest point of contention between the two paradigms is the role environmental selection plays in firm survival rates. Winters (1964) contends that in order for selection to occur, there must be some criterion on which to select. Applying Darwinist notions to firms implies that those who consistently display profit maximizing behavior will be "selected" for survival. Winters argues that, due to environmental complexity and informational asymmetries, managers do not consistently display profit maximizing behavior. Instead, managers make decisions which actually result in a *satisficing* rather than *optimizing* of objectives. Without consistent profit maximization the selection argument breaks down.

Given that industrial economics is a branch of economics, a social science, human behavior and choice are factored into industrial economic models. Industrial economists would allow for a higher level of adaptability in explaining firm survival rates compared to population ecology models. Industrial economists would also contend that this capacity to adapt is something which can be learned. For example, Scherer points out that the professionalization of managers in the post World War II economy may factor into a firm's ability to survive in a complex and dynamic environment. This stands in contrast to the role of management in the earlier industrial economy in which basic industry and food processing enterprises were the primary large-scale organizations. In these types of organizations the role of management was confined to the production and sale of a largely undifferentiated output.

Although much of the theoretical basis for industrial economics is derived from microeconomics analysis, there also exist differences between the two disciplines. Traditional microeconomic theory views the firm as a "black box" in which inputs are transferred into outputs. Industrial economics is broader in scope and investigates the processes involved in collectivizing productive activities. Another key difference is that industrial economic models are less rigid when compared to traditional microeconomic models; this flexibility allows for "explanations rich in both quantitative and institutional detail." (Scherer, 1980).

Market Factors

In the population ecology paradigm, emphasis is placed on the availability and control of resources as a determinant of firm survival rates. Industrial economics analyzes the emergence and disappearance of entire industries in a framework in which *both* supply and demand factors account for broad shifts in industrial activity.

In economic analysis an increase in demand for a certain good or service, with a constant supply, would initially cause its price to increase. Higher prices are a signal which attracts new entrepreneurs to this activity. As more firms compete for a fixed supply of factors of production—land, labor, capital—their prices would also rise which is a reflection of their limited supply. However, over time this upward pressure on prices for production inputs is checked by one of two possible forces. In a scenario compatible with the population ecology paradigm, inefficient producers are "selected" out as profits margins are squeezed. Eventually as fewer participants compete for resources the market returns to a new equilibrium level. An alternative scenario would allow for an increase in the resource flow to this industry. This dynamic interaction between supply and demand variables forms the underlying basis of industrial economic analysis.

A further point of distinction between the two paradigms centers around the genesis of broad shifts in industrial patterns. Population ecologists would argue for a "supply-sided" interpretation: industries are born and die as resources are initially exploited and eventually exhausted which are fundamental to the production process of a

particular industry. Industrial economists interpret this movement from a demand-sided perspective: shifting patterns in aggregate demand translate into fundamental structural changes in the economy which lead to the birth and death of entire industries.

As a country moves through stages of industrial development the composition of its GDP changes. A mature economy is characterized by a small percentage of aggregate output derived from agricultural and extractive industries with the service sector accounting for a significant portion of GDP. The population ecology paradigm may actually fit those economies in their early stages of development; i.e., where there are many producers and sellers of primary products. These markets are close to the economic definition of competitive in that the actions of any one participant cannot affect such variables as price and market structure. However, most of the industrial output in the U.S. is actually produced by oligopolies—firms with enough power to set prices and significantly influence market structure. It is within this context that organizational births are analyzed.

Births

Industrial economists would agree with population ecologists that environmental forces constrain the formation of new industries. Although industrial economists do not deny the importance of resource availability on organizational formation, their studies emphasize another environmental factor as a constraining force on organizational formations: the reactions of incumbent firms to new market participants.

Oligopolies erect barriers to entry which serve to limit the number of organizations contained in a given market segment. Caves and Porter (1977), list several practices incumbent firms utilize to deter market entry. For example, incumbent organizations may acquire supplies of inputs in excess of their own production needs with the intent of sealing off these resources from potential competitors. Another practice oligopolistic organizations engage in is to set prices such as that it would be unprofitable for new firms to enter the market; the essence of this practice is captured in Bain's Limit Pricing model.

This framework, which incorporates the interaction of competitors' actions with resource availability, allows organizational theorists to study the origins of organizations in a richer context.

Deaths

Industrial economists are also concerned with the death or disappearance of firms. At the aggregate level, disappearances of entire industries can be traced to broad shifts in consumer demand.

Population ecologists classify vertical integration, or the absorption of one organization by another, as an organizational death. Recapping, population ecologists contend that organizations die when, in their current form, they are unable to survive in their environment. Industrial economists view the process of vertical integration in a much more proactive light: companies integrate in order to reduce uncertainties, secure a resource base and achieve economies of scale. It is a process of controlling, rather than being controlled by, the environment.

Scherer (1980) contends that at the organization level firms, especially small, owner-managed firms, cease to exist for a variety of reasons: lack of successors, inheritance tax implications and the desire of the owner-manager to "lead the quiet life." Studies referenced by Scherer conclude that most small firms were actually profitable in the years immediately prior to their acquisition. This stands in contrast to the population ecology argument that unprofitable firms are "selected" out by their environment.

SUMMARY AND CONCLUSIONS

This paper has given an overview of population ecology and industrial economics, paradigms which researchers use to study organizations at the macro level. This paper has also critiqued the population ecology paradigm and sets forth the proposition that industrial economics serves as a better framework for studying organizations in an aggregate context.

The following points summarize the theoretical and methodological problems with the population ecology paradigm. First of all, resources are viewed as the sole determinant of organizational survival rates to the exclusion of all other variables. Organizational life is too complex and varied to be reduced to a single variable.

Secondly, the methodological problems of overlaying biological theories to the study of organizations are many. Since industrial economics is also a social science there exists a closer fit between it and organizational theory. According to Scherer one of the objectives of industrial economics is to formulate, "theories that permit us to predict ultimate market performance from the observation of structure, basic conditions, and conduct." (Scherer, 1980, p. 3).

Lastly, the population ecology paradigm is not a positive theory in the sense that it accurately describes the world as it exists. The assumptions on which it rests, a fixed resource base, competitive markets, environmental selection, and a one-to-one mapping between an organization and its niche, not only are vastly oversimplifying, but frankly do not capture the context in which most organizations operate.

In conclusion, the population ecology paradigm has contributed little to the foundations of organizational theory in the nearly two decades of its existence. On the surface the paradigm is intriguing; however, its useful to researchers remains questionable. Organizational theorists who wish to conduct research at the industry level are better served by adopting the framework of industrial economics.

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